

A Comparison of Wild and Cultured Salween Creek Coho Salmon: 1982 Tagging Summary

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by

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CONTENTS

	<u>Page</u>
LIST OF TABLES AND FIGURES	v
LIST OF APPENDICES	vi
ABSTRACT/Résumé.....	vii
INTRODUCTION	1
WATERSHED DESCRIPTION AND SALMONID RESOURCE	1
METHODS	3
EXPERIMENTAL DESIGN.....	3
CULTURED COHO.....	3
WILD COHO.....	4
Capture Techniques.....	4
Fence Trapping.....	4
Minnow Trapping.....	4
Tagging Procedures.....	4
Biological Sampling.....	5
RESULTS.....	5
FENCE TRAPPING	5
Catches	5
Migration Timing.....	6
Coho Smolts	6
Chum Fry	6
Trout Smolts	6
Periodicity	6
MINNOW TRAPPING.....	8
COHO SMOLT TAGGING.....	8
BIOLOGICAL SAMPLING.....	8
Coho Smolt Age.....	8
Coho Smolt Length and Weight	8
DISCUSSION.....	11
CATCHES.....	11
MIGRATION TIMING.....	11
BIOLOGICAL SAMPLING.....	11
ENHANCEMENT IMPLICATIONS.....	12
Coho Salmon.....	12
Steelhead Trout.....	13

	<u>Page</u>
SUMMARY	13
ACKNOWLEDGEMENTS	13
LITERATURE CITED	14
APPENDICES	15

LIST OF TABLES AND FIGURES

<u>Table</u>	<u>Page</u>
1. Summary of 1982 Salwein Creek coho smolt CWT releases.....	6
2. Weighted mean fork lengths and wet weights of 1982 Salwein Creek wild coho smolts, by age class.....	8
3. 1982 Salwein Creek coho smolt migration timing, by age class.....	9

<u>Figure</u>	
1. Study area location map	2
2. 1982 Emigration of Salwein Creek salmonids in relation to date and water temperature.....	7
3. Weekly summary of 1982 coho smolt mean fork lengths	10



LIST OF APPENDICES

<u>Appendix</u>	<u>Page</u>
1. (a) 1982 daily fence trap catches in Salwein Creek.....	16
(b) 1982 morning and afternoon fence trap catches in Salwein Creek.....	18
2. 1982 daily minnow trap catches in Salwein Creek.....	18
3. (a) 1982 Salwein Creek wild coho smolt tagging results.....	19
(b) Incidence of anomalies encountered while tagging wild Salwein Creek coho smolts during 1982.....	19
4. 1982 Salwein Creek (wild) coho length frequency distribution.....	20
5. Summary of Salwein Creek salmon escapements.....	22

ABSTRACT

Schubert, N.D. 1984. A comparison of wild and cultured Salwein Creek coho salmon: 1982 tagging summary. Can. MS Rep. Fish. Aquat. Sci. 1739: vii + 22p.

Wild and cultured components of the Salwein Creek coho stock were coded wire tagged to assess relative survivals and marine catch distributions. One group of 11,815 (code 02 21 15) wild coho and three groups of cultured coho totalling 60,279 (codes 02 22 46, 02 21 14, and 02 22 31) were released with tags. This report documents the wild trapping and tagging program and briefly summarizes the fish cultural history of the enhanced group.

Key Words: Salwein Creek, coho salmon, coded wire tagging, wild/cultured comparison

Résumé

Schubert, N.D. 1984. A comparison of wild and cultured Salwein Creek coho salmon: 1982 tagging summary. Can. MS Rep. Fish. Aquat. Sci. 1739: vii + 22p.

Des spécimens sauvage et d'élevage du stock de saumon coho du ruisseau Salwein ont été marqués au moyen d'une étiquette métallique codée, pour l'évaluation des taux relatifs de survie et de la distribution des prises en mer. Un groupe 11,815 (code 02 21 15) saumons cohos sauvages et trois groupes de saumons cohos d'élevage totalisant 60,279 individus étiquetés (codes 02 22 46, 02 21 14, 02 22 31) ont été libérés. Le présent rapport détaille le programme de capture et d'étiquetage des spécimens sauvages et fait un bref historique de l'élevage des poissons du groupe mis en valeur.

Mots-clés: ruisseau Salwein, saumon coho, pose d'une étiquette métallique codée, comparaison entre les spécimens sauvages et d'élevage.

INTRODUCTION

A number of coded wire tagging (CWT) studies were recently initiated in the Fraser River system to assess the exploitation rate, catch distribution and survival rate of specific coho stocks (Schubert 1982, Fedorenko and Cook 1982, Schubert 1982 MS, Hutton et al. 1983 MS, Cook 1983 MS). Such studies play an important role in the formulation of management strategies for the Fraser River coho resource; however, high costs have generally limited these studies to a maximum three years duration, precluding an assessment of harvest distribution patterns for more than one cycle. One method proposed to obtain such data over a longer time series involves indexing wild stocks to hatchery production groups in the same geographical area. Although it is generally accepted that post smoltification survivals of wild and hatchery coho differ, it remains unclear if fish cultural practices also influence marine distribution and harvest patterns. The purpose of the current study, therefore, was to assess, through coded wire tagging, both the wild and cultured components of a single coho stock in a preliminary investigation of the feasibility of managing wild stocks on the basis of hatchery production assessment information.

The 1982 trapping and coded wire tagging study was conducted in Salwein Creek, a small tributary of the Vedder River located near Chilliwack, B.C. (Figure 1). This stream was selected for four reasons: First, enhancement of Salwein Creek coho did not begin until 1980; therefore, the study results will not be biased by any genetic effects arising from potential wild/cultured parental crosses. Second, comparative data are available from a baseline CWT study conducted in the system between 1976 and 1978 (Fedorenko and Cook 1982). Third, the apparent productivity of the stream is sufficient to satisfy the minimum statistical constraints associated with a preliminary study, while the small,

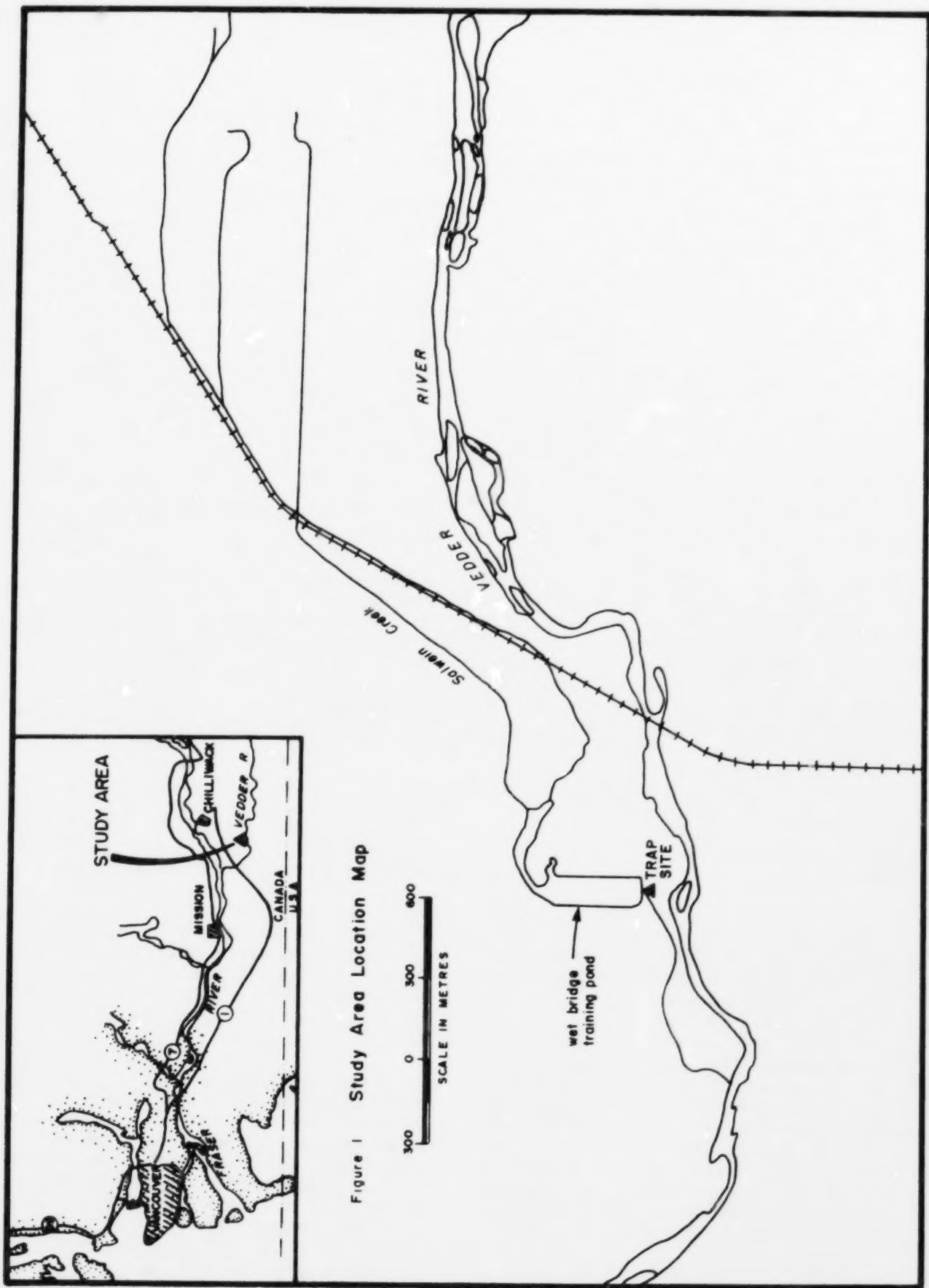
stable nature of the stream greatly simplified trapping considerations. And finally, subsequent spawner assessment could be conducted by hatchery brood stock acquisition crews.

This report documents the wild coho smolt capture and CWT techniques and results, including the daily catch by species, migration timing and smolt age and size characteristics. Also summarized are the Chilliwack River Hatchery fish culture procedures, coded wire tagging results and release strategies. The report concludes with a discussion of the implications of current coho enhancement strategies in the Fraser River system.

WATERSHED DESCRIPTION AND SALMONID RESOURCE

Salwein Creek is a small lowland tributary of the Vedder portion of the Vedder-Chilliwack River, a large system entering the Fraser River from the south near Chilliwack, B.C. (Figure 1). Salwein Creek flows primarily in drainage ditches through farmland for approximately 3.2 km, entering the Vedder River 7 km upstream from the Fraser River. The upper portion of the stream is typified by a pool/run habitat and scattered gravel deposits as it flows in two ditched channels which join at a large pond (locally termed the "Wet Bridge Training Area") excavated in the stream by the Department of National Defence. The stream flows from the pond through a fish ladder and trapping facility and meanders in a single channel for the remaining 0.8 km to the Vedder River.

Salwein Creek supports runs of coho, chum and pink salmon (Appendix 5) as well as cutthroat trout and an enhanced run of steelhead trout. Coho salmon are predominant, with an average escapement of 210 during the period 1951 to 1982 and a recent five year average of 425.



Coho spawn between mid November and late January in the upper reaches of the creek. Chum and pink salmon spawn primarily below the pond. Trout spawning distributions have not been assessed.

METHODS

EXPERIMENTAL DESIGN

The objective of the 1982 study was to assess the influence of standard fish cultural practices on subsequent marine harvest distributions. The study was designed to detect a 1.25 difference in survival to catch between the wild and cultured groups in four major fisheries: the Georgia Strait troll fishery, the Georgia Strait sport fishery, the troll fishery off the west coast of Vancouver Island and the combined Puget Sound fisheries. The research and null hypothesis are stated more formally below:

$$H_1: S_{wi} \neq S_{ci}$$

$$H_0: S_{wi} = S_{ci}$$

where S denotes survival to catch of wild group w and the cultured group c in the i th fishery. Since hatchery practices are known to influence smolt to adult survivals, subsequent analyses will first correct for apparent differences in total survival. The selected level of significance, $p < 0.15$, reflects the preliminary nature of the study.

The number of cultured smolts released with coded wire tags (60,279) was determined independently from this study. The wild tagging requirement necessary to fulfill the study objectives was estimated from a statistical comparison of projected catches in each fishing area. The following factors were considered: the cultured group size; the estimated smolt to adult survival; the harvest rates and catch distributions recorded in a previous assessment of Vedder-Chilliwack coho (DFO unpublished); and a minimum catch sample rate of 20%. The minimum tag-

ging group size for wild coho was estimated at 13,000 smolts, near the apparent productive limit of Salwein Creek (Fedorenko and Cook 1982).

CULTURED COHO

Coho brood stock was obtained from Salwein Creek between December 14, 1980 and February 6, 1981. A total of 51 females were crossed with 34 males to produce approximately 117,900 fertilized eggs which were incubated in Heath trays at the Chilliwack River Hatchery. The temperature regime of each group was manipulated by mixing river and pumped ground water in order to minimize the range in hatching times resulting from the extended brood stock acquisition period. After hatching, the 0.25 g fry were initially reared in 'Capilano' troughs prior to transfer to rearing channels at a size of 2 - 2.5 g. Standard fish cultural practices during extended rearing included scheduled feeding with a commercial moist (30% water) food preparation (Oregon Moist Pellets), and routine bimonthly sampling for mean length and weight. All coho were released as smolts in May, 1982 at a mean weight of 25 g. Survivals, adjusted for unexplained channel losses, averaged 94.9% during incubation and 77.7% during rearing. More detailed records are on file at the Chilliwack River Hatchery (L. Schubert, pers. comm.)

The enhancement strategy developed for the Fraser River coho stocks involves 'satelliting' depressed stocks to a central hatchery facility for incubation and rearing prior to final imprinting and release at the stream of origin. As the first major coho production facility in the Fraser River system, the initial releases from the Chilliwack River Hatchery were designed to assess the effectiveness of various release strategies. Salwein Creek coho were separated into three tag groups in order to assess the degree of stray-

ing under different imprinting regimes. The first group of 20,542 (code 02 22 46) was to be held for fifteen days in pens in Salwein Creek; the second group of 19,821 (code 02 21 14) was spot released into Salwein Creek; and the final group of 19,916 (code 02 22 31) was released from the hatchery. Unfortunately, suboptimal conditions in Salwein Creek necessitated the release of the first group after twenty-four hours. All other groups were released as planned.

WILD COHO

Capture Techniques

Fence Trapping: A fence trap similar to that described by Armstrong and Argue (1977) was the primary smolt capture method used during this program. The fence consisted of a series of 0.8 m x 2.4 m wooden frame panels covered with 6 mm galvanized mesh screening. These panels were installed in a converging V pattern, diverting all emigrant fish into a sluice trough which dropped into a large holding box. A by-pass was constructed in one wing of the fence to allow steelhead spawners to pass upstream unhindered; however, steelhead were reluctant to approach the fence and tended to spawn downstream.

The fence was installed on April 16 at a site located immediately downstream from the Wet Bridge Training Pond (Figure 1). This site was selected in order to intercept any fish emigrating from Rust Creek, a small silty tributary which enters Salwein Creek below the pond.

The fence trap catches were enumerated at least once daily, with twice daily enumeration on twenty-four occasions to assess the diel pattern of migration. All coho smolts were transferred to nearby plywood holding boxes where they were held for tagging and sampling. Coho fry were not enumerated because the 6 mm mesh on the trap box was too large to fully restrict passage

of the smaller individuals. Trout were enumerated by species and recorded as smolts or presmolts. Smolts were defined as those fish with a silver coloration and with a fork length generally greater than 11 cm. Presmolts were defined as those fish with distinct parr marks and with a fork length less than 11 cm. Recently emergent trout fry were not enumerated. All other species were enumerated and released below the fence.

Water temperatures were recorded twice daily with a pocket thermometer. Water levels were not recorded due to an absence of suitable gauge sites; however, flows were low and constant throughout the program.

Minnow Trapping: Minnow traps baited with Fraser River chum salmon roe were set in the lower 0.8 km of stream between the trap and the Vedder River. Up to twenty-five traps were set each day during the period April 19 to 23. Trapping was suspended on April 23 to avoid recapturing previously coded wire tagged fish; however, trapping success had declined significantly by that time.

Tagging Procedures

The coded wire tagging equipment and machine maintenance procedures used during the study were similar to those described by Armstrong and Argue (1977). Tagging commenced on April 23 and tagging operations were conducted twice per week. On each tagging day, the tag implant location was checked for each tag lot by bisecting the skull of a tagged coho with a scalpel along the median plane. If the tag was not in the preferred position in the cartilaginous wedge of the skull (the chondrocranium), the implant depth was adjusted and the procedure repeated until tag placement was correct. Following this check the remaining smolts were tagged.

During the tagging operation, the

fish were anesthetized using a stock Tricaine Methane Sulphonate (TMS) solution of 7.5 g per liter of water which was further diluted, as conditions dictated, in a 7.5 l plastic basin. The smolts were first graded into two size classes, based on 95-100 mm fork length cut off between groups, and separate nose molds and tag implant depths were used for each group to ensure proper tag location. All sizes of coho smolts were tagged; however, any diseased or damaged fish were noted and excluded from tagging. The graded smolts were then marked by adipose fin removal, tagged, and passed through the quality control device (QCD) to ensure the tag was present. A random sample of 100 to 600 smolts was removed from the recovery bucket throughout each tagging operation and retained for forty-eight hour mortality and tag retention assessments. Any smolts without pins were retagged, and the tag lot figures were adjusted to reflect the numbers released with tags. All other tagged smolts were allowed to recover from the anesthetic before release below the fence.

All 1982 wild Salween Creek coho smolts were tagged with the same code: 02 21 15.

Biological Sampling

Coho smolts were sampled twice weekly to assess changes in smolt age and size with time. Fifty smolts were removed randomly from the daily catch and anesthetized in the TMS solution described above. A scale smear was removed with a scalpel from the "preferred region", as defined by Clutter and Whitesel (1956), and the nose-fork length was measured to the nearest millimeter. A mean wet weight was derived from a subsample of at least 25 smolts weighed in aggregate (± 0.1 gram) on an Ohaus triple beam balance. On two occasions, the above procedure was conducted on both morning and afternoon catches in order to assess any differences in age or size between nocturnal and

diurnal migrants.

RESULTS

FENCE TRAPPING

Catches

Daily fence trap catches are reported in Appendix 1. A total of 11,682 coho smolts and 4,899 chum fry were captured during the period April 17 to June 14. Other species captured during that period included: 66 steelhead smolts (of which 9 were marked with an adipose clip), 21 steelhead presmolts (or rainbow fry), 34 cutthroat smolts and 2 cutthroat presmolts. The following nonsalmonid species were also captured, in descending order of abundance: western brook lampreys (*Lampetra richardsoni*), crayfish (*Pacifastacus* sp.), threespine sticklebacks (*Gasterosteus aculeatus*), northern squawfish (*Ptychocheilus oregonensis*), prickly sculpins (*Cottus asper*), reddsided shiners (*Richardsonius balteatus*), lamprey amocoetes, bridgelip suckers (*Catostomus columbianus*), river lampreys (*Lampetra ayresi*), peamouth chub (*Mylocheilus caurinus*), Pacific lampreys (*Entosphenus tridentatus*), and aleutian sculpins (*Cottus aleuticus*).

Operational problems occurred on three occasions during 1982. The fence overflowed on May 18 and May 25 in response to a very heavy load of Eurasian milfoil (*Myriophyllum spicatum*) which occurred coincident with a period of warm, sunny weather. On June 15, backwatering from a rapid spring runoff in the Vedder River forced program termination when the trap was inundated in 1.5 meters of water. This problem had not been encountered during the 1976 through 1978 programs.

An important observation associated with the fence trap operation

involves a release of approximately 20,000 steelhead smolts immediately below the fence site on May 5. Significant numbers of the fish were observed near the release site as late as June 13 when rising water levels prevented further observation.

Migration Timing

Coho Smolts: Coho smolts emigrated primarily between early May and mid June when the trap became ineffective (Figure 2). The 50% migration, as defined by the date of 50% smolt catch, occurred on May 22 and the largest daily catch occurred on May 28.

Chum Fry: The chum fry migration commenced prior to program implementation and continued until the end of May. The 50% migration occurred on May 5 and the largest daily catch occurred on April 19; however, these data are likely biased by the late start of the capture period.

Trout Smolts: Migration timing of trout smolts could not be determined due to low catch levels.

Periodicity: On the twenty-four occasions monitored, the diurnal component of the diel migration averaged 36.0% for coho smolts, 33.3% for steelhead smolts, 21.4% for chum fry and 12.5% for cutthroat smolts (Appendix 1b) (Note: these figures represent minimum estimates of diurnal periodicity since many of the 1700 h to 0800 h migrants may have been trapped prior to dusk or after dawn). Diurnal movements were recorded throughout the study period, with the largest diurnal catches normally coincident with peak twenty-four hour catches.

Nocturnal and diurnal coho emigrants were sampled for age and size on May 17 and May 24. On both days, the nocturnal emigrants were slightly larger than the diurnal emigrants (103.5 mm and 10.6 g vs 101.9 mm and 10.4 g on May 17; 99.9 mm and 9.7 g vs 99.7 mm and 9.5 g on May 24); however, the difference was not significant in either case. Age composition was also identical.

Table 1. Summary of 1982 Salween Creek coho smolt CWT releases.

Group	Tag Code	Release Date	Number Tagged	Number marked and tag lost	Number released with tags
Wild	02 21 15	April 23 - June 18	12,216	444	11,815
Cultured, 24 hr release	02 22 46	May 6	20,729	187	20,542
Cultured, spot release	02 21 14	May 17	20,082	261	19,821
Cultured, hatchery release	02 22 31	May 10	20,077	161	19,916

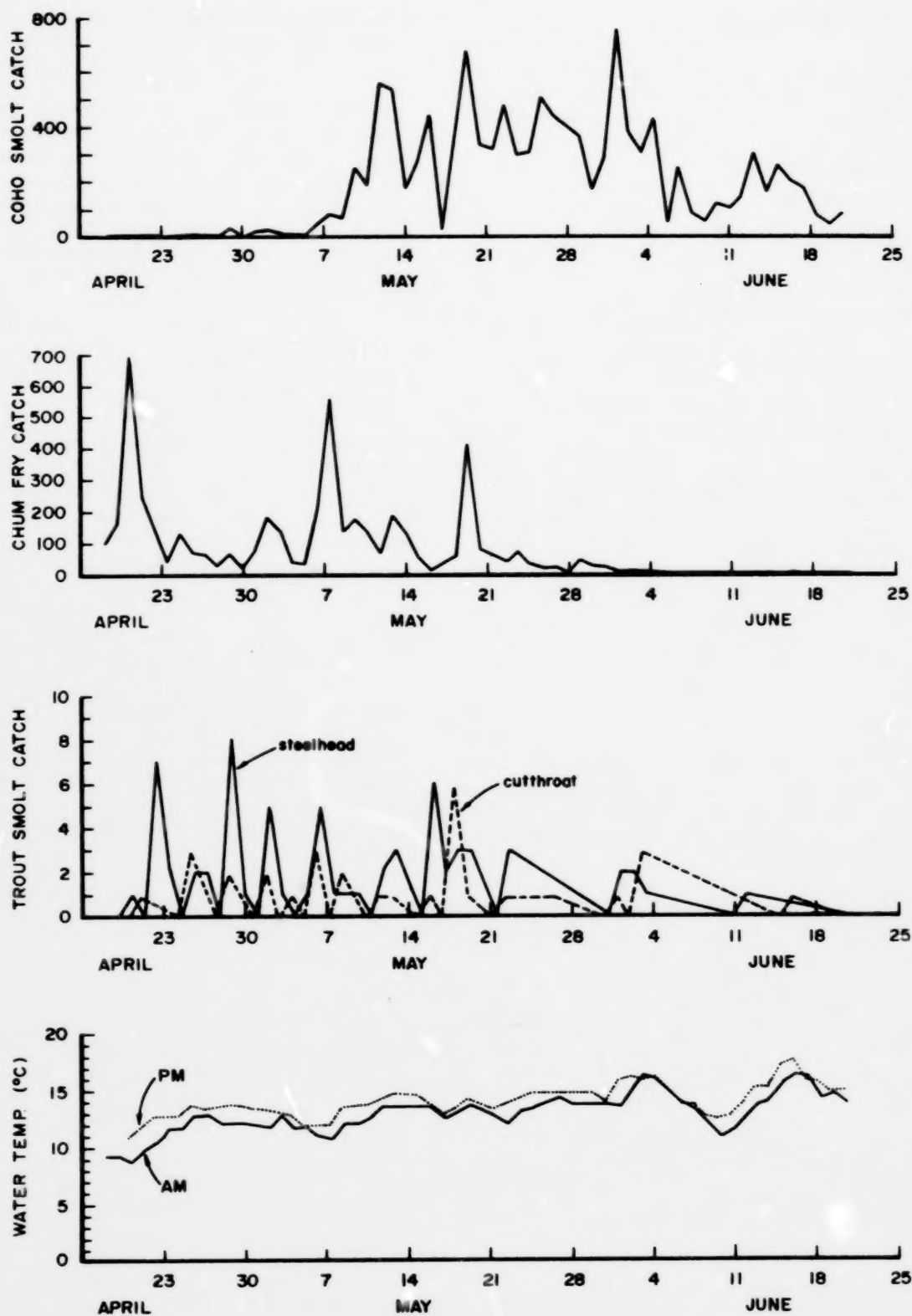


Figure 2 1982 emigration of Salwein Creek Salmonids in relation to date and water temperature.

MINNOW TRAPPING

Coho smolt minnow trap catches in Salwein Creek totalled 575 (Appendix 2) and comprised 4.7% of the total coho catch. Catch per trap-day averaged approximately 4.7.

COHO SMOLT TAGGING

Table 1 summarizes all 1982 coded wire tag releases of Salwein Creek coho. Detailed tagging summaries for the cultured groups are on file at the Chilliwack River Hatchery; wild coho CWT results are reported in Appendix 3a and are summarized below.

A total of 12,261 wild coho smolts were adipose clipped and coded wire tagged during 1982. When adjustments are made for delayed tag loss and mortality, the total number released with tags was 11,815. Delayed tag loss averaged an unusually high 4.2% (N=2,800) with a daily range of 0% to 21.6%. Holding and post tagging mortality were negligible. The incidence of diseased or damaged smolts encountered during the program was 3.4% (Appendix 3b). The most prevalent condition encountered was an opaque clouding of the eye, commonly termed 'fog-eye', a reversible condition believed to be

associated with capture and holding stress (G. Hoskins, pers. comm.). The incidence of naturally missing adipose fins was 0.009% (1 fish) and will not significantly influence the subsequent mark ratio. It should be noted, however, that the term 'naturally missing adipose' denotes a deformed fin which might be mistaken for an incomplete clip. No fish with completely missing fins were noted.

BIOLOGICAL SAMPLING

Coho Smolt Age

Coho smolts emigrated from Salwein Creek primarily as yearlings or age 1+ smolts (99%), with two-year-old or age 2+ smolts forming the remainder of the run (Table 2). Age 2+ smolts tended to emigrate in the later part of the run, with the 50% peak of age 2+ individuals occurring almost a week after than that of age 1+ smolts (Table 3).

Coho Smolt Length and Weight

The weighted mean length of 1982 Salwein coho smolts was 102.9 mm (Table 2). Two-year-old smolts averaged 109.4 mm and were larger

Table 2. Weighted mean fork lengths and wet weights of 1982 Salwein Creek wild coho smolts, by age class (Data derived from Appendix 4).

Age	Percent Composition	Mean Fork Length(mm)	Mean Wet Weight(g)	Number per kilogram
1+	99.0%	102.9	10.6*	94.3
2+	1.0%	109.4	12.7*	78.7
Combined	100.0%	102.9	10.5**	94.3

* calculated from regression

** weighted mean derived from weekly sample data (Fig. 3).

Table 3. 1982 Salween Creek coho smolt migration timing, by age class.

Week ending:	April		May		June		Total
	30	7	14	21	28	4	18*
Age 1+	N 124 Cum. % 1.1	476 5.2	2,180 24.0	2,752 47.8	2,911 73.0	1,539 86.3	325 100
Age 2+	N 2 Cum. % 1.8	0 1.8	0 1.8	40 36.8	22 56.1	16 70.2	7 100
Total	N 126 Cum. % 1.1	476 5.2	2,180 23.8	2,792 47.7	2,933 72.8	1,555 86.1	332 100

* Fence inundated June 15, 1982

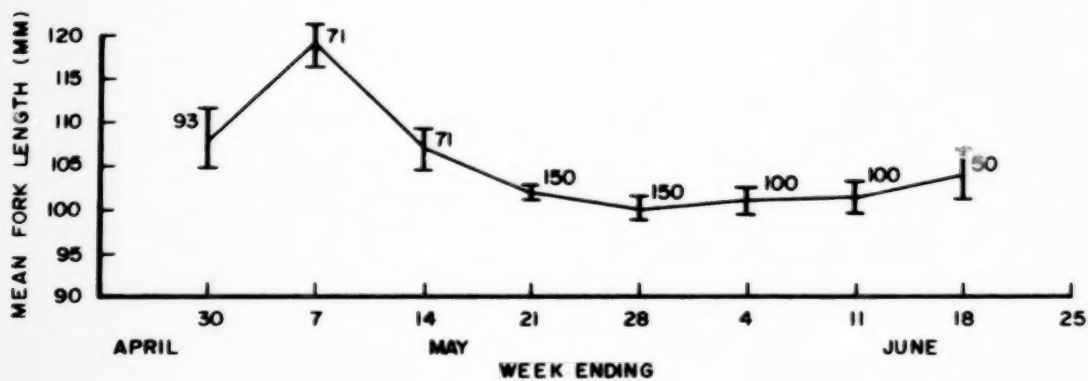


Figure 3 Weekly summary of 1982 coho smolt mean fork lengths (numerals represent sample sizes ; vertical bars are 95 % confidence limits)

than yearling smolts, which averaged 102.9 mm; however, the difference was not significant ($p < 0.05$).

The weighted mean weight of Salwein Creek coho smolts was 10.5 g in 1982 (Table 2). Mean weights of age 1+ and 2+ smolts were derived by calculating a logarithmic functional regression of weight on length from the bi-weekly sample data:

$$\ln \text{ weight (g)} = -11.12 + 2.91 \ln \text{ length (mm)}$$

$$r = 0.98$$

The mean weights of age 1+ and 2+ smolts were 10.6 g and 12.7 g respectively.

Changes in coho smolt length with time are shown in Figure 3. The mean length increased to a peak in early May and generally decreased through the remainder of the run.

DISCUSSION

CATCHES

The 1982 catch of 11,682 coho smolts was similar to or larger than those reported in Salwein Creek by Fedorenko and Cook (1982) and is likely near the upper productive limit of the stream. Caution is urged, however, in relating the reported catch levels to habitat parameters. No effort was made to assess the capture efficiency of the trap, nor did the capture period include the later portion of the emigration. Consequently, catch totals likely underestimate the total annual smolt production.

Assuming survivals and catch distributions similar to those observed in the 1976 to 1978 Vedder-Chilliwack CWT study (DFO unpublished), returns from the 1982 study should detect, at an 85% level of confidence, a 1.25 between group difference in catch in the following fisheries:

the Georgia Strait sport and troll fisheries, the troll fishery off the west coast of Vancouver Island, and the combined Puget Sound fisheries. The selected level of confidence reflects the preliminary nature of the study. Greater precision or a finer fishing area breakdown requires a larger tagged wild group.

MIGRATION TIMING

The pattern of coho smolt emigration from Salwein Creek was similar to that reported by Fedorenko and Cook (1982), with peaks occurring in late May. This pattern was considerably later than those reported in other nearby coastal streams. Migratory peaks generally occurred by mid May in the Salmon River (Schubert 1982), the Campbell River (Schubert 1983), the Squamish River (Argue and Armstrong 1977), and in two other Vedder-Chilliwack tributaries (Fedorenko and Cook 1982). No correlation was noted between the onset and pattern of migration and daily water temperatures (Figure 2).

Throughout the trapping period, a significant proportion of the salmonid emigration occurred during daylight hours. A similar observation was reported in the Salmon and Campbell Rivers (Schubert 1982, 1983). Age and size compositions were similar in diurnal and nocturnal migrants, suggesting that the stimulus which releases diurnal migratory behavior acts on the entire population rather than a specific, identifiable segment. No correlation was noted between the intensity of diurnal migration and water temperature; however, temperatures may have remained above a critical releasing threshold throughout the study.

BIOLOGICAL SAMPLING

In 1982, coho emigrated from Salwein Creek primarily as yearlings

with age 2+ individuals comprising only 1.1% of the sample. By comparison, Fedorenko and Cook (1982) reported age 2+ components of 6.4%, 3.4% and 3.2% in 1976, 1977 and 1978, respectively. This variation likely reflects differences in brood year strength and subsequent environmental conditions. Available data sources did not permit an analysis of this relationship.

The average coho smolt size in 1982 was similar to or larger than that reported by Fedorenko and Cook (1982), although differences in sampling methodology complicate comparisons. The seasonal pattern in smolt size was also similar, with an initial increase followed by an extended decline in smolt size. This suggests that the initially smaller individuals remain in the stream for several weeks of extended rearing prior to emigration.

ENHANCEMENT IMPLICATIONS

Coho Salmon

One of the enhancement strategies developed for Fraser River coho stocks involves 'satelliting' depressed stocks to a central hatchery facility for incubation and rearing prior to final imprinting and release at the stream of origin. The intent of this strategy is to augment natural production in order to return sufficient spawners to fully utilize the available spawning and rearing habitat. Enhancement in Salwein Creek is a first implementation of that strategy and provides an opportunity for preliminary evaluation.

The 1982 enhancement effort in Salwein Creek was intended to increase coho escapements to the creek and to assess imprinting strategies. Approximately 40,800 cultured coho smolts were released into Salwein Creek to augment a minimum 12,000 smolts produced naturally in the stream. Assuming standard survival and exploitation rates (Wood et al. 1979), adult production will total approximately 8,000 of which approximately 2,000 will return to

spawn. Although optimum escapement levels are unknown, empirical data regarding past escapement levels, habitat availability and maximum recorded smolt catches indicate the projected 1983 escapement will exceed stream capacities. Consequences may include superimposition of spawners as well as potential genetic effects resulting from the high proportion of cultured fish on the spawning grounds.

The above problems emphasize data deficiencies in the overall coho smolt satelliting strategy. The strategy presupposes a knowledge of target stream carrying capacity, the escapement level associated with that capacity, and the relationship between current and optimum escapement levels. Unfortunately, these data are unavailable for most Fraser River coho streams, predisposing future smolt outplants to problems similar to those encountered in Salwein Creek.

An alternative strategy which would expose hatchery outplants to the selective pressures of the nursery stream environment as well as link subsequent production to habitat carrying capacity involves spring outplants of coho presmolts. In 1980, Oregon's Department of Fish and Wildlife implemented a pre-smolt program involving the release of approximately six million coho presmolts in ninety-five coastal streams (Nickelson 1981). A preliminary assessment of the initial three years of that program suggests that summer coho rearing densities can be significantly increased by outplants of 2 g fry during the spring (Solazzi et al. 1983). Their assessment also suggests, however, that this strategy can negatively impact wild stocks if implemented in the absence of information concerning wild coho fry density. Solazzi et al. (1983) reported a post planting depression of wild juvenile coho production of up to 50% in some streams, possibly

reflecting the effects of a large cultured/wild size differential acting on high preplant rearing densities of wild coho.

Clearly, the future effectiveness of the satellite strategy, whether involving fry or smolt plants, will be contingent upon a rigorous assessment of stream carrying capacities and escape-ment optima as well as ongoing assessment of current production levels. It is strongly recommended that these data be collected prior to or coincident with further full scale enhancement of coho stocks in the Fraser River system.

Steelhead Trout

Another consideration relating to enhancement activities in Salwein Creek involves a release of approximately 20,000 steelhead smolts on May 5. Although the Fish and Wildlife Branch conducted no poststocking assessment, empirical information obtained incidentally to routine trap maintenance procedures indicated that a substantial portion of the planted smolts remained in the stream through the study period. If the proportion of nonemigrants is similar to the minimum 50% reported from a similar plant in the Campbell River (Schubert 1983), then a considerable potential exists for detrimental impacts through predation on recently emergent coho fry. A thorough reexamination of the steelhead smolt outplant strategy is strongly indicated.

SUMMARY

1. Wild and cultured components of the 1980 brood Salwein Creek coho were coded wire tagged in order to assess relative survivals and catch distributions in four major fisheries. One group of 11,815 wild smolts (code 02 21 15) and three groups of 20,542 (code 02 22 46), 19,821 (code 02 21 14) and 19,916 (code 02 22 31) cultured smolts were released with tags.

2. Wild smolts emigrated primarily between early May and mid June, with the peak migration occurring in late May. The wild smolts were 99% age 1+ and averaged 102.9 mm in length and 10.5 g in weight.
3. Survival of the cultured smolts averaged 94.9% during incubation and 77.7% during rearing. The smolts were released in three groups at two sites between May 6 and May 17. The cultured smolts averaged 25 g in weight.
4. The enhancement strategy developed for Fraser River coho salmon was reviewed in relation to 1982 activities in Salwein Creek. It was concluded that current information regarding stream carrying capacities and optimum escape-ments is insufficient to ensure successful implementation of the 'satellite' enhancement strategy.
5. Empirical information indicates that current steelhead enhancement strategies may detrimentally impact wild coho stocks. A re-examination of the outplant strategy is indicated.

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APPENDICES

APPENDIX 1(A). 1982 DAILY FENCE TRAP CATCHES IN SALMON CREEK.

DATE	WATER TEMP (C)	CONO SNOLTS	CHUM FRY	STEELHEAD		CUTTTHROAT		PAC.		BROOK		LAMPREYS		SCULPINS		STICK- LEBACK		CRAY- FISH		PEA- MOUTH CHUB		SQUAM FISH		RED- SIDED SHINER		BRIDGE LIP SUCKER	
				SNOLTS	PRE-SM	SNOLTS	PRE-SM	SNOLTS	PRE-SM	SNOLTS	PRE-SM	RIVER	ANOCDE	PRIKLY	ALEUT												
APR 17	9.50	0	99	0	0	3	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	9.50	1	162	0	0	1	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	9.00	6	693	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	10.00	2	243	0	0	1	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	10.75	4	140	0	0	2	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	12.00	1	42	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	13.00	7	134	0	0	0	0	0	0	0	0	21	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	13.25	10	67	2	0	0	3	0	0	0	0	55	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	13.25	8	63	2	0	3	0	0	0	0	0	29	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	12.50	1	28	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	12.50	35	70	8	0	0	2	0	0	0	0	23	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	12.50	2	22	1	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	12.25	21	77	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	12.00	28	183	5	1	0	2	0	0	0	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAY 1	11.00	12	137	1	1	1	0	0	0	0	0	14	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	12.00	6	40	0	0	0	1	0	0	0	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	12.00	6	32	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	11.25	51	200	5	0	0	3	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	11.00	83	560	1	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	12.50	44	136	1	0	0	2	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	11.00	254	177	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	13.00	183	130	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	14.00	561	69	2	0	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	14.00	539	190	3	0	0	1	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	14.00	171	131	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	14.00	269	57	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	13.75	436	11	6	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	12.75	21	38	2	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	13.50	382	61	3	0	0	6	0	0	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	14.00	679	406	3	1	1	1	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	13.50	334	85	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	13.00	317	58	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	12.25	480	40	0	0	1	1	0	0	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	13.50	242	75	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	13.75	308	30	0	0	0	1	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	14.25	507	21	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	14.75	440	24	0	0	1	1	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	14.00	403	4	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	14.00	365	48	0	0	0	0	0	0	0	0	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

CONTINUED

APPENDIX I(A). 1982 DAILY FENCE TRAP CATCHES IN SALMEIN CREEK.

DATE	WATER TEMP (C)	CHUM FRY	STEELHEAD		CUTTHROAT		LAMPREYS			SCULPINS		STICK-LEBACK	CRAY-FISH	PEA-MOUTH CHUB	SQUAM FISH	RED-SIDED SHINER	RED-BRIDGE LIP SUCKER
			SMOLTS	PRE-SM	SMOLTS	PRE-SM	BROOK	RIVER	ANOCDE	PRICKLY	ALEUT						
MAY 26	14.00	169	26	0	0	0	0	5	0	8	2	0	7	0	3	2	0
27	14.00	289	23	0	0	0	0	5	0	1	5	0	7	0	0	1	1
28	13.75	760	10	2	1	0	1	5	0	0	1	0	8	0	4	2	6
29	15.50	378	13	2	0	0	0	5	0	2	4	0	5	0	3	1	3
30	16.75	307	8	1	3	0	0	0	0	0	5	0	4	0	7	1	4
31	16.00	438	6	0	0	0	0	0	0	1	3	0	14	0	11	1	1
JUN 1	14.00	50	1	0	0	0	1	3	0	0	3	0	2	0	7	1	1
2	14.00	251	2	0	0	0	2	1	0	0	3	0	3	0	1	1	0
3	13.50	80	3	0	0	0	4	0	0	0	4	0	2	0	0	1	0
4	12.25	51	1	0	0	0	0	0	0	0	5	0	10	0	1	0	0
5	11.00	121	1	0	0	0	0	0	0	0	3	0	9	1	7	0	1
6	11.75	101	1	0	0	0	0	0	0	0	2	0	7	0	0	0	0
7	13.00	150	6	1	0	0	3	0	0	0	3	0	18	0	5	1	1
8	14.00	304	4	0	2	0	0	0	0	2	0	0	15	0	3	0	0
9	14.50	154	0	0	0	0	0	0	0	4	1	0	14	0	1	1	0
10	16.00	259	0	0	0	0	1	0	0	0	2	0	7	0	0	0	0
11	16.75	199	9	0	1	0	6	1	1	1	5	1	17	0	2	0	0
12	16.50	176	0	0	0	0	3	0	0	0	1	0	11	0	0	5	1
13	14.50	72	2	0	0	0	1	0	0	1	2	0	5	0	4	3	0
14	15.00	84	0	0	0	0	1	0	0	0	0	0	4	0	0	0	0
TOTAL		11682	4899	66	21	34	2	380	21	55	138	1	149	20	146	64	24

PRE-SM = PRESNOLT
PAC. = PACIFIC
BROOK = WESTERN BROOK
ANOCDE = ANOCDETE
PRICKLY = PRICKLY
ALEUT = ALEUTIAN

APPENDIX 1(B). 1982 MORNING AND AFTERNOON FENCE TRAP CATCHES IN SALWEIN CREEK.

DATE	WATER TEMP (C)		CONO SMOLTS		CHUM FRY		STEELHEAD SMOLTS		CUTTHROAT SMOLTS	
	NIGHT	DAY	NIGHT	DAY	NIGHT	DAY	NIGHT	DAY	NIGHT	DAY
APR 24	13.25	14.00	9	1	66	7	2	0	3	0
28	-	14.00	1	1	13	9	0	1	0	0
29	12.25	13.50	16	5	75	2	0	0	0	0
30	12.00	13.50	21	7	68	115	4	4	1	1
MAY 5	11.00	12.25	63	20	421	139	0	1	0	0
6	12.50	13.75	33	31	107	29	1	0	2	0
10	14.00	15.00	125	332	177	7	0	3	1	0
12	14.00	14.75	206	63	54	3	0	0	0	0
13	13.75	13.75	424	12	11	0	6	0	1	0
14	12.75	13.00	21	0	33	5	2	0	0	0
17	13.50	14.00	113	221	83	2	0	0	0	0
19	12.25	14.00	291	189	29	11	3	0	0	1
20	13.50	14.50	236	56	70	5	0	0	1	0
21	13.75	15.00	139	169	24	6	0	0	1	0
25	14.00	15.00	243	122	35	13	0	0	1	0
26	14.00	15.00	65	104	23	3	0	0	0	0
27	14.00	14.00	224	65	22	1	0	0	0	0
28	13.75	16.00	637	123	8	2	2	0	1	0
31	16.00	16.50	312	126	5	1	0	1	0	0
JUN 3	13.50	13.75	19	61	1	2	0	0	0	0
4	12.25	12.75	15	36	0	1	0	0	0	0
9	14.50	15.50	131	23	0	0	0	0	0	0
10	16.00	17.50	97	162	0	0	0	0	1	0
11	16.75	18.00	122	77	8	1	0	0	1	0
TOTAL	-	-	3563	2006	1333	364	20	10	14	2

NOTE - 'NIGHT' DENOTES THE CAPTURE PERIOD 1700H TO 0800H; 'DAY' DENOTES THE PERIOD 0800H TO 1700H.

APPENDIX 2. 1982 DAILY MINNOW TRAP CATCHES IN SALWEIN CREEK.

DATE	NUMBER TRAPPING OF DURATION TRAPS (HRS)		CATCHES				
			CONO SMOLTS	TROUT	SCUL-PIN	STICK-LEBACK	LAMPREY
APR 19	21	6	60	10	19	1	0
20	27	15	207	11	45	30	1
21	25	24	149	10	56	1	0
21	25	8	61	10	30	3	0
22	25	15	57	22	41	10	0
23	25	24	41	10	62	15	0
TOTAL			575	73	253	60	1

1 CATCHES OTHER THAN CONO WERE NOT IDENTIFIED TO THE SPECIES LEVEL TO AVOID HANDLING STRESS.

APPENDIX 3(A). 1982 SALWEIN CREEK WILD CONDO SMOLT TAGGING RESULTS (CODE 02 21 15).

TAGGING DATE	MAXIMUM HOLDING TIME (DAYS)	PRE- RELEASED TAGGING MORTALITY	TOTAL NUMBER WITHOUT TAGGING MARKED	TOTAL NUMBER MARKED	48 HOUR REJECT RATE		TOTAL MARKED AND WITHOUT TAGS		POST TAGGING MORTALITY		TOTAL RELEASED WITH TAGS
					8N	%	ADIPOSE ONLY	88TAG LOST	IMMED- IATE	88848 HOUR	
APR 23	5	2	1	580	580	0.50	0	0	0	0	580
MAY 3	10	2	3	122	122	3.30	0	0	0	0	122
10	7	6	4	1683	186	5.40	0	81	0	0	1602
14	4	12	2	902	121	0.80	0	7	0	0	895
17	3	2	3	1302	205	0.00	0	0	0	0	1302
21	4	4	6	1512	257	0.00	0	0	0	0	1512
25	4	6	6	1688	281	2.80	4	40	1	0	1643
28	3	5	1	1226	308	4.50	1	42	0	0	1183
JUN 1	4	3	9	1211	301	21.60	0	197	0	0	1014
7	6	3	2	765	162	7.00	0	43	0	0	722
11	4	3	12	885	277	0.40	0	4	0	4	877
18	7	2	4	385	-	4.20	6	16	0	0	363
TOTAL		50	53	12261	2800	4.20	11	430	1	4	11815

* SAMPLE SIZE HELD TO ASSESS TAG LOSS.

** BASED ON % REJECT RATE APPLIED TO ENTIRE TAG LOT.

*** BASED ON MORTALITY RATE OBSERVED IN QCD SUBSAMPLE EXPANDED TO ENTIRE TAG LOT.

APPENDIX 3(B). INCIDENCE OF ANOMALIES ENCOUNTERED WHILE TAGGING WILD SALWEIN CREEK CONDO SALMON SMOLTS DURING 1982 (SECOND FIGURE INDICATES A SEVERE ANOMALY WHICH WAS RELEASED UNTAGGED).

DATE	NUMBER INSPECTED	FOG EYE	MESCUIS	EXOP- THALMIA	SCALE LOSS	FIN EROSION	FIN LORDOSIS	OPERC- ULUM DAMAGE	GENERAL DAMAGE	NATUR- ALLY MISSING ADIPOSE
APR 23	583	1/0	-	-	3/0	-	-	-	0/1	-
MAY 3	127	-	-	-	-	-	-	-	0/3	-
10	1693	12/0	-	-	3/3	1/0	0/1	1/0	-	-
14	916	9/0	-	-	3/0	-	-	-	0/2	-
17	1307	17/0	-	-	2/0	-	1/1	-	0/2	-
21	1522	15/0	1/0	-	10/0	1/0	0/2	-	1/4	-
25	1700	19/0	-	0/2	6/0	2/0	0/2	-	0/2	-
28	1232	48/0	-	-	3/0	2/1	1/0	-	1/0	-
JUN 1	1223	10/0	-	0/1	10/4	4/0	-	3/1	2/3	1
7	770	42/0	-	-	5/1	1/0	-	1/0	0/1	-
11	900	105/1	-	0/2	9/2	3/1	-	-	0/6	-
18	391	-	-	-	3/0	3/1	-	-	0/3	-
TOTAL	12364	278/1	1/0	0/5	57/10	17/3	2/6	5/1	4/27	1
% TOTAL	-	2.26	.01	.04	.54	.16	.06	.05	.25	.01

APPENDIX 4. 1982 SALWEIN CREEK (WILD) COHO LENGTH-FREQUENCY DISTRIBUTION.

WEEK ENDING:	APRIL 30		MAY 7		MAY 14		MAY 21		MAY 28		JUNE 4	
	1+	2+ TOTAL	1+	2+ TOTAL	1+	2+ TOTAL	1+	2+ TOTAL	1+	2+ TOTAL	1+	2+ TOTAL
AGE:												
FORK LENGTH (MM)												
70-74	2	2	-	-	-	-	-	-	-	-	-	-
75-79	-	-	-	-	-	-	-	-	-	-	-	-
80-84	3	3	-	-	-	-	-	-	-	-	-	-
85-89	6	6	-	-	-	-	-	-	-	-	-	-
90-94	11	11	2	2	5	5	16	16	21	21	15	15
95-99	11	12	2	2	11	12	39	42	49	51	28	29
100-104	13	13	3	3	14	15	42	43	28	31	24	26
105-109	10	10	7	8	19	19	23	24	21	21	16	17
110-114	6	6	13	14	10	10	13	14	7	10	10	10
115-119	8	10	15	17	4	5	4	4	5	6	1	1
120-124	6	7	9	10	1	1	1	2	-	-	-	-
125-129	2	2	2	3	-	-	1	1	-	-	-	-
130-134	3	3	3	3	1	2	-	-	-	-	-	-
135-139	1	1	1	3	1	1	-	-	-	-	-	-
140-144	3	3	1	1	-	-	-	-	-	-	-	-
145-149	2	2	1	1	-	-	-	-	-	-	-	-
150-154	1	1	1	1	1	1	-	-	-	-	-	-
155-159	-	-	-	-	-	-	-	-	-	-	-	-
160-164	-	-	-	-	-	-	-	-	-	-	-	-
165-169	1	1	-	-	-	-	-	-	-	-	-	-
170-174	-	-	1	1	-	-	-	-	-	-	-	-
SAMPLE SIZE	89	93	65	71	67	71	141	150	137	150	96	100
% TOTAL	98.9	1.1	100	0	100	0	99	1	99	1	99	1
MEAN LENGTH	107.5	119	119.1	118.8	106.5	106.8	102	112	99.7	118	99.9	101.1
STANDARD DEV.	18.2	0	15.1	14.6	10.2	10.5	6.7	12.7	6.5	6.8	6.7	6.7
MEAN WEIGHT (g)	-	11.9	-	15.7	-	12.3	-	-	-	-	-	10
SAMPLE SIZE	-	64	-	48	-	47	-	-	-	-	-	67

CONTINUED

APPENDIX 4. 1982 SALWEIN CREEK (WILD) COMO LENGTH-FREQUENCY DISTRIBUTION.

WEEK ENDING:	JUNE 11		JUNE 18		TOTAL	
	1+	2+	1+	2+	1+	2+
AGE:	1+	2+	1+	2+	1+	2+
FORK LENGTH (MM)						
70-74	-	-	-	-	2	-
75-79	-	-	-	-	-	-
80-84	-	-	-	-	-	5
85-89	5	-	1	-	20	21
90-94	11	-	2	-	83	87
95-99	25	-	12	-	177	186
100-104	26	2	11	-	161	170
105-109	14	-	16	-	122	127
110-114	8	-	9	1	74	81
115-119	4	-	4	2	43	49
120-124	-	-	2	-	20	23
125-129	1	-	1	-	6	7
130-134	-	-	-	-	-	8
135-139	-	-	-	-	5	5
140-144	-	-	-	-	4	4
145-149	-	-	-	-	3	3
150-154	-	-	-	-	3	3
155-159	-	-	-	-	1	1
160-164	-	-	-	-	1	1
165-169	-	-	-	-	1	1
170-174	-	-	-	-	1	1
SAMPLE SIZE	94	2	100	49	1	50
Σ TOTAL	98	2	-	98	2	-
MEAN LENGTH	101.2	102.5	101.4	103.8	111	104
STANDARD DEV.	7.5	2.1	7.5	7.2	7.2	8.6
MEAN WEIGHT (g)	-	-	10.4	-	11.7	-
SAMPLE SIZE	-	-	82	-	50	-
						566

APPENDIX 5. SUMMARY OF SALMETN CREEK SALMON ESCAPEMENTS.

YEAR	COHO	CHUM	PINK	YEAR	COHO	CHUM	PINK
1951	N/R	0	0	1970	75	50	-
1952	75	25	-	1971	200	25	0
1953	25	25	25	1972	100	25	-
1954	25	25	-	1973	900	100	150
1955	75	25	25	1974	500	25	-
1956	25	25	-	1975	100	20	50
1957	25	75	25	1976	527	25	-
1958	75	25	-	1977	649	50	0
1959	75	75	25	1978	724	0	-
1960	25	25	-	1979	400	0	0
1961	75	75	25	1980	50	25	-
1962	75	200	-	1981	250	0	500
1963	25	25	25	1982	700	0	-
1964	75	25	-				
1965	200	25	25	AVERAGE			
1966	200	75	-				
1967	75	15	20	51-60	47	33	20
1968	120	25	-	61-70	102	57	10
1969	100	50	0	71-80	415	30	20
				78-82	425	5	250